

(Problem 1-4)

Solution to Problem 5-5

Species	Rate In	Rate Out	$\Delta n$	out - In	Rxn. 1 $\xi$
CO	308	41	-267	-1	267
H <sub>2</sub>	954	91	-863	-3	288
CH <sub>4</sub>	//	327	316	1	316
H <sub>2</sub> O	2	269	267	1	267
CO <sub>2</sub>	92	92	0	0	-
N <sub>2</sub>	//	//	0	0	-

1) The system does not behave as though one, stoichiometrically-single reaction is taking place. The values of  $\xi$ , calculated with the stoichiometric coefficients for Rxn. 1, are not the same for all four species.

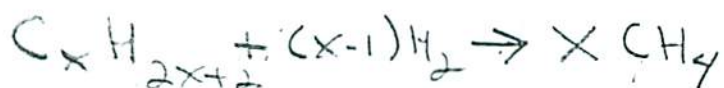
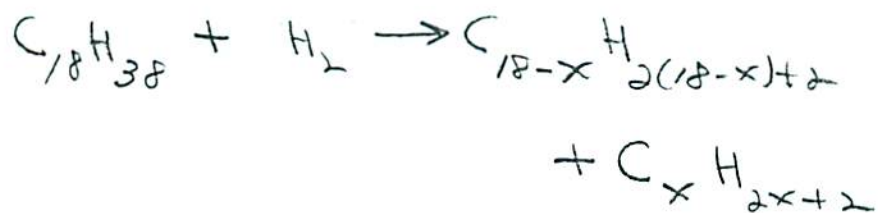
2)  $\xi$  has the same value for CO and H<sub>2</sub>O. However, there is more CH<sub>4</sub> being produced and more H<sub>2</sub> being consumed than suggested by the  $\xi$  values for CO and H<sub>2</sub>O.

"Extra" moles of CH<sub>4</sub> formed =  $316 - 267 = 49$

Cover and above what we can account for from  $\xi$  value for CO and H<sub>2</sub>O.

"Extra" moles of H<sub>2</sub> consumed =  $863 - 3 \times 267$   
 $= 62$

This suggests that the hydrocarbon liquid is reacting with H<sub>2</sub>.



The first reaction consumes  $H_2$  without producing  $CH_4$ . The second reaction produces roughly 1 mole of  $CH_4$  / mole  $H_2$  consumed. This is consistent with the data.

3) Suggestions:

a) Check to see if the hydrocarbon liquid is being consumed (check level periodically, weigh at end of run, etc.)

b) analyze the exit gas for other hydrocarbons —  $C_2H_6$ ,  $C_3H_8$ , etc.